CLAIMS

What is claimed is:

1. A compact apparatus for forming a high contrast, low distortion image of a patterned object including:

a light refractor for reflecting and refracting light, the light refractor including:

an imaging surface against which a patterned object to be imaged is to be placed to form an apparent image of the patterned object in the light refractor;

a viewing surface adjacent to the imaging surface and through which an image of the object to be imaged is projected, the viewing surface forming an angle γ with the imaging surface; and

a further surface adjacent to the imaging surface

at least one lens adjacent to the viewing surface and for receiving and focusing an image of a patterned object projected through the viewing surface, the lens having a lens plane which is perpendicular to an optical axis of the lens, the lens plane forming an angle δ with the viewing surface;

wherein the angles γ and δ are formed to substantially equalize a path length of a first light ray traveling from one part of the apparent image of the patterned object to the lens plane with a path length of any other light ray substantially parallel to the first light ray and traveling from another part of the apparent image of the patterned object to the lens plane.

2. The apparatus of claim 1 wherein the angles γ and δ are related by the equation:

$$0.7 \leq (n^2 - \sin^2\delta)^{1/2}(\cot\gamma)(\sin\delta)+\sin^2\delta \leq 1.3$$

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3. The apparatus of claim 1 wherein the angles γ and δ are related by the equation:

$$0.85 \leq (n^2 - \sin^2\delta)^{1/2}(\cot\gamma)(\sin\delta)+\sin^2\delta \leq 1.15$$

4. The apparatus of claim 1 wherein the angles γ and δ are related by the equation:

$$0.925 \leq (n^2 - \sin^2\delta)^{1/2}(\cot\gamma)(\sin\delta)+\sin^2\delta \leq 1.075$$

5. The apparatus of claim 1 wherein the part of the imaging surface against which an object to be imaged is to be placed is able to have at least one light ray scattered from each portion thereof such that the intersection of the at least one light ray and the viewing surface form a first angle, ~~adjacent to the intersection of the viewing surface and the imaging surface~~, which is less than 90 degrees.

6. The apparatus of claim 1 further including at least one light source located adjacent to the light refractor and for emitting incident light which enters the light refractor to create an image of the patterned object at the viewing surface.

7. The apparatus of claim 6 wherein:

the ~~triangular prism~~ light refractor includes:

a first edge opposite the imaging surface and adjacent to the viewing surface; and

the light source is a strip of light emitting diodes (LEDs) oriented towards and parallel with the viewing surface and adjacent to the first edge.

8. The apparatus of claim 1 wherein:

the at least one lens has a diameter;

the object to be imaged has a length dimension; and

the diameter of the at least one lens is smaller than the length dimension of the object to be imaged.

9. The apparatus of claim 2 wherein the part of the imaging surface against which an object to be imaged is to be placed is able to have at least one light ray scattered from each portion thereof such that the intersection of the at least one light ray and the viewing surface form a first angle, ~~adjacent to the intersection of the viewing surface and the imaging surface~~, which is less than 90 degrees.

10. The apparatus of claim 3 wherein the part of the imaging surface against which an object to be imaged is to be placed is able to have at least one light ray scattered from each portion thereof such that the intersection of the at least one light ray and the viewing surface form a first angle, ~~adjacent to the intersection of the viewing surface and the imaging surface~~, which is less than 90 degrees.

11. The apparatus of claim 4 wherein the part of the imaging surface against which an object to be imaged is to be placed is able to have at least one light ray scattered from each portion thereof such that the intersection of the at least one light ray and the viewing surface form a first angle, ~~adjacent to the intersection of the viewing surface and the imaging surface~~, which is less than 90 degrees.

12. A method of imaging a patterned object comprising:

providing a light refractor having an imaging surface, a viewing surface and a further surface;

forming an angle γ between a plane defined by the viewing surface and a plane defined by the imaging surface;

placing the patterned object against the imaging surface of the light refractor;

projecting incident light into the light refractor;

scattering the incident light off the imaging surface and patterned object and through the viewing surface;

providing a lens adjacent to the viewing surface;

forming an angle δ between the plane defined by the viewing surface and a lens plane of the lens;

fixing angles δ and angle γ to equalize a path length of a first light ray traveling from one part of an apparent image of the patterned object in the light refractor to the lens plane with a path length of any other light ray substantially parallel to the first light ray and traveling from another part of the apparent image of the patterned object to the lens plane.

13. The method of claim 12 wherein the step of fixing angle δ and angle γ includes relating angle δ and angle γ according to the equation:

$$0.7 \preceq (n^2 - \sin^2\delta)^{1/2}(\cot\gamma)(\sin\delta)+\sin^2\delta \preceq 1.3$$

14. The method of claim 13 wherein the step of fixing angle δ and angle γ includes relating angle δ and angle γ according to the equation:

$$0.85 \preceq (n^2 - \sin^2\delta)^{1/2}(\cot\gamma)(\sin\delta)+\sin^2\delta \preceq 1.15$$

15. The method of claim 12 wherein the step of fixing angle δ and angle γ includes relating angle δ and angle γ according to the equation:

$$0.925 \preceq (n^2 - \sin^2\delta)^{1/2}(\cot\gamma)(\sin\delta)+\sin^2\delta \preceq 1.075$$

16. The method of claim 12 wherein the step of placing the patterned object against the imaging surface includes placing the patterned object against portions of the imaging surface which are able to have at least one light ray scattered therefrom such that the intersection of the at least one light ray and the viewing surface form a first angle, ~~adjacent to the intersection of the viewing surface and the imaging surface~~, which is less than 90 degrees.

17. The method of claim 13 wherein the step of placing the patterned object against the imaging surface includes placing the patterned object against portions of the imaging surface which are able to have at least one light ray scattered therefrom such that the intersection of the at least one light ray and the viewing

surface form a first angle, ~~adjacent to the intersection of the viewing surface and the imaging surface~~, which is less than 90 degrees.

18. The method of claim 14 wherein the step of placing the patterned object against the imaging surface includes placing the patterned object against portions of the imaging surface which are able to have at least one light ray scattered therefrom such that the intersection of the at least one light ray and the viewing surface form a first angle, ~~adjacent to the intersection of the viewing surface and the imaging surface~~, which is less than 90 degrees.

19. The method of claim 15 wherein the step of placing the patterned object against the imaging surface includes placing the patterned object against portions of the imaging surface which are able to have at least one light ray scattered therefrom such that the intersection of the at least one light ray and the viewing surface form a first angle, ~~adjacent to the intersection of the viewing surface and the imaging surface~~, which is less than 90 degrees.